



## **WATER RESOURCES RESEARCH GRANT PROPOSAL**

**Project ID:** 2005WY24B

**Title:** Real-Time Monitoring of E. Coli Contamination in Wyoming

**Project Type:** Research

**Focus Categories:** Water Quality, Methods

**Keywords:** Water Quality Monitoring, Bacteria, Biomonitoring, Bioindicators

**Start Date:** 03/01/2005

**End Date:** 02/28/2006

**Federal Funds:** \$35,500

**Non-Federal Matching Funds:** \$79,088

**Congressional District:** 1

**Principal Investigator:**

Paul E. Johnson

### **Abstract**

This project will demonstrate the feasibility of economical, simultaneous, real-time detection of individual *Escherichia coli* and their viability in surface waters. The Clean Water Act requires states to monitor surface waters for fecal coliforms or specifically for *E. coli*. Fecal coliform monitoring is an indicator of the sanitary quality of the water and can determine the extent of fecal contamination in the water from warm-blooded animals. Fecal contamination is important from a public standpoint when the surface water's designated use includes contact recreation such as beach use, boating, or swimming. It has been shown that *E. coli* enumeration is more accurate than fecal coliform enumeration in assessing the potential of surface waters to transmit infectious diseases to humans via contact recreation. A low-cost, portable, highly sensitive, self-contained single cell detection system for *E. coli* enumeration is proposed for rapid monitoring of surface waters, including streams, rivers, and lakes. With previous USGS/WWDC funding, the P-I and his team have demonstrated an innovative technique for detection of pathogenic microorganisms in surface water, economically and in real time. This technology is based on laser-induced fluorescence of antibody- and DNA-labeled cells. The proposed project will demonstrate the detection of individual *E. coli* simultaneously in two wavebands in order to detect and determine viability of individual microorganisms. The suspended bacteria are stained using both an immunofluorescent

antibody and a fluorescent cell viability label. The resulting aqueous sample is passed as a stream in front of an LED, which excites the fluorescent labels. The resulting fluorescence is measured with a CCD imager using an innovative integration scheme (called Fountain Flow), giving a dramatically higher signal-to-noise ratio than conventional techniques. In addition, we propose to investigate the extension of the fountain flow technology to imaging, to provide increased discrimination capability among *E. coli*, other biological particles, and small geological particles.

The major tasks of this project will be to: 1.) fabricate and test a two-color, LED-illuminated detection system in order to simultaneously detect and determine the viability of *E. coli*, 2.) perform laboratory measurements on quantified *E. coli* samples to determine the detection efficiency and sensitivity of the two-color monitoring system, 3.) enumerate *E. coli* in stream and lake water samples using both our proposed method and the standard method currently recommended by the US Environmental Protection Agency, 4.) determine the feasibility of a rare-cell, fountain flow imaging system based on an extension of our current technology, and 4.) fabricate and test a prototype fountain flow imaging system for proof of concept.